TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B124

A reactor startup is in progress. Which one of the following statements describes the response to control rod withdrawal when taking the reactor critical?

A. The nuclear instrumentation will take longer to stabilize at each new subcritical level.

B. The reactor will be critical when the period and power level remain constant, with no further rod withdrawal.

C. Each complete control rod withdrawal will result in the same amount of change in subcritical power level.

D. Each control rod withdrawal results in an initial negative period followed by a strong positive period.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B130

Which one of the following statements describes subcritical multiplication during a reactor startup?

A. Subcritical multiplication is the process of using source neutrons to maintain an equilibrium neutron population when K_{eff} is less than 1.

B. As K_{eff} approaches unity, a smaller change in neutron level occurs for a given change in K_{eff}.

C. The equilibrium subcritical neutron level is dependent on the source strength and the time between successive reactivity insertions.

D. As K_{eff} approaches unity, less time is required to reach the equilibrium neutron level for a given change in K_{eff}.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B176

A reactor is being taken critical by periodically withdrawing control rods in equal reactivity increments. Which one of the following statements describes reactor conditions as K_{eff} approaches unity?

A. The neutron level change for successive rod increment pulls becomes smaller.

B. A longer period of time is required to reach the equilibrium neutron level after each rod withdrawal.

C. A rod withdrawal will result in the reactor becoming slightly supercritical due to a "prompt jump" and then return to a subcritical level.

D. If the rod withdrawal is stopped for several hours the neutron level will decrease to source level.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B349

Of the following conditions, which group is necessary for subcritical multiplication to occur?

A. Neutron source, moderator, and fissionable material

B. Moderator, fission product decay, and K_{eff} less than one

C. K_{eff} less than one, gamma source, and fissionable material

D. Fissionable material, gamma source, and K_{eff} greater than one

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B350 (P347)

Which one of the following is a characteristic of subcritical multiplication?

A. The subcritical neutron level is directly proportional to the neutron source strength.

B. Doubling the indicated count rate by reactivity additions will reduce the margin to criticality by approximately one quarter.

C. For equal reactivity additions, it takes less time for the new equilibrium source range count rate to be reached as K_{eff} approaches unity.

D. An incremental withdrawal of any given control rod will produce an equivalent equilibrium count rate increase, whether K_{eff} is 0.88 or 0.92.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B449

A reactor startup is being performed with xenon-free conditions. Rod withdrawal is stopped just prior to criticality and neutron count rate is allowed to stabilize. No additional operator actions are taken.

During the next 30 minutes count rate will...

A. remain essentially constant.

B. slowly decrease and stabilize due to long-lived delayed neutron precursors.

C. slowly decrease to its prestartup level due to buildup of xenon-135.

D. slowly increase to criticality due to long-lived delayed neutron precursors.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B967 (P3149)

Which one of the following describes the purpose of a neutron source that is installed in a reactor during refueling for the third fuel cycle?

A. Ensures shutdown neutron level is large enough to be detected by nuclear instrumentation.

B. Provides additional excess reactivity to increase the length of the fuel cycle.

C. Amplifies the electrical noise fluctuations observed in source/startup range instrumentation during shutdown.

D. Supplies the only shutdown source of neutrons available to begin a reactor startup.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1170 (P1848)

A nuclear power plant that has been operating at rated power for two months experiences a reactor scram. Two months after the reactor scram, with all control rods still fully inserted, a stable count rate of 20 cps is indicated on the source range nuclear instruments.

The majority of the source range detector output is being caused by the interaction of ____________ with the detector.

A. intrinsic source neutrons

B. fission gammas from previous power operation

C. fission neutrons from subcritical multiplication

D. delayed fission neutrons from previous power operation

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1449 (P1348)

A reactor is shut down by 1.8% $\Delta K/K$. Positive reactivity is added which increases stable neutron count rate from 15 to 300 cps.

What is the current value of K_{eff}?

A. 0.982

B. 0.990

C. 0.995

D. 0.999

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1549 (P1549)

Which one of the following intrinsic/natural neutron sources undergoes the most significant source strength reduction during the 1-hour period immediately following a reactor scram from steady-state 100% power?

A. Spontaneous fission reactions

B. Photo-neutron reactions

C. Alpha-neutron reactions

D. Transuranic isotope decay

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1849 (P1448)

A subcritical reactor has an initial source/startup range count rate of 150 cps with a shutdown reactivity of -2.0% ΔK/K. Approximately how much positive reactivity must be added to establish a stable count rate of 600 cps?

A. 0.5% ΔK/K

B. 1.0% ΔK/K

C. 1.5% ΔK/K

D. 2.0% ΔK/K

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B1949 (P448)

A subcritical reactor has an initial source range count rate of 150 cps with a shutdown reactivity of -2.0% ΔK/K. How much positive reactivity must be added to establish a stable count rate of 300 cps?

A. 0.5% ΔK/K

B. 1.0% ΔK/K

C. 1.5% ΔK/K

D. 2.0% ΔK/K

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2149 (P848)

A subcritical reactor has an initial K_{eff} of 0.8 at a source range count rate of 100 cps. Positive reactivity is added until K_{eff} equals 0.95. What will be the final equilibrium source range count rate?

A. 150 cps

B. 200 cps

C. 300 cps

D. 400 cps

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2150 (P2149)

After the first fuel cycle, subcritical multiplication can produce a visible neutron level indication on the source range nuclear instrumentation for a significant time period following a reactor shutdown without installed neutron sources. This is because a sufficient number of source neutrons is being produced by intrinsic sources, with the largest contributor during the first few days after shutdown being...

A. spontaneous neutron emission from control rods.

B. photo-neutron reactions in the moderator.

C. spontaneous fission in the fuel.

D. alpha-neutron reactions in the fuel.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2249 (P2248)

Two reactors are currently shut down with a reactor startup in progress. The two reactors are identical except that reactor A has a source neutron strength of 100 neutrons per second and reactor B source neutron strength is 200 neutrons per second. Control rods are stationary and Keff is 0.98 in both reactors. Core neutron level has reached equilibrium in both reactors.

Which one of the following lists the core neutron level (neutrons per second) in reactors A and B?

	Reactor A	Reactor B
A.	5,000	10,000
B.	10,000	20,000
C.	10,000	40,000
D.	20,000	40,000

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2449

Two reactors are currently shut down with a reactor startup in progress. The two reactors are identical except that reactor A has a source neutron strength of 100 neutrons per second and reactor B source neutron strength is 80 neutrons per second. Control rods are stationary and K_{eff} is 0.98 in both reactors. Core neutron level has reached equilibrium in both reactors.

Which one of the following lists the core neutron level (neutrons per second) in reactors A and B?

	Reactor A	Reactor B
A.	5,000	4,000
B.	5,000	1,600
C.	2,000	1,600
D.	2,000	400

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2649 (P2448)

A reactor startup is being performed with xenon-free conditions. Control rod withdrawal is stopped when K_{eff} equals 0.995 and count rate stabilizes at 1000 cps. No additional operator actions are taken.

Which one of the following describes the count rate 20 minutes after rod withdrawal is stopped?

A. Less than 1000 cps and decreasing toward the prestartup count rate.

B. Less than 1000 cps and stable above the prestartup count rate.

C. Greater than 1000 cps and increasing toward criticality.

D. 1000 cps and constant.

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B2949

A reactor plant is being cooled down from 400°F to 250°F. Just prior to commencing the cooldown, readings for all source range nuclear instruments were 32 counts per second (cps). After two hours, with reactor coolant temperature at 300°F, source range count rate is 64 cps.

Assuming that the moderator temperature coefficient remains constant throughout the cooldown, what will be the status of the reactor when reactor coolant temperature reaches 250°F?

A. Subcritical, with source range count rate below 150 cps

B. Subcritical, with source range count rate above 150 cps

C. Critical, with source range count rate below 150 cps

D. Critical, with source range count rate above 150 cps

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B3049 (P3048)

A reactor startup is being commenced with initial source (startup) range count rate stable at 20 cps. After a period of control rod withdrawal, count rate stabilizes at 80 cps.

If the total reactivity added by the above control rod withdrawal is 4.5 %ΔK/K, how much additional positive reactivity must be inserted to make the reactor critical?

A. 1.5 %ΔK/K

B. 2.0 %ΔK/K

C. 2.5 %ΔK/K

D. 3.0 %ΔK/K

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/30]
QID: B3849 (P3848)

A reactor is shutdown with a K_{eff} of 0.8. The source range count rate is stable at 800 cps. What percentage of the core neutron population is being contributed directly by neutron sources other than neutron-induced fission?

A. 10%

B. 20%

C. 80%

D. 100%

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.01 [2.9/3.0]
QID: B3925 (P3925)

A reactor startup is in progress at a nuclear power plant with core K_{eff} equal to 0.90. By what factor will the core neutron level have increased when the reactor is stabilized with core K_{eff} equal to 0.99?

A. 10

B. 100

C. 1,000

D. 10,000

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B48

Which one of the following is the definition for delayed neutron fraction?

A. Fraction of the total number of delayed neutrons produced from fission, born from delayed neutron precursors

B. Fraction of the total number of fast neutrons produced from fission, born from delayed neutron precursors

C. Fraction of the total number of neutrons produced from fission, born from delayed neutron precursors

D. Fraction of the total number of thermal neutrons produced from fission, born from delayed neutron precursors

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B351

Which one of the following describes how and why the effective delayed neutron fraction varies over core life?

A. Increases due to the burnup of U-238

B. Decreases due to the buildup of Pu-239

C. Increases due to the buildup of Pu-239

D. Decreases due to the burnup of U-238

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B371

At the end of core life, the majority of power is generated by fission of which of the following two isotopes?

A. U-235 and U-238

B. Pu-241 and U-238

C. Pu-239 and U-238

D. Pu-239 and U-235

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B850

The average effective delayed neutron fraction ($\overline{\beta}_{eff}$) can be defined as...

A. $\dfrac{\text{number of neutrons born delayed}}{\text{total number of neutrons born from fission}}$

B. $\dfrac{\text{number of neutrons born delayed}}{\text{number of neutrons born prompt}}$

C. $\dfrac{\text{number of fissions caused by delayed neutrons}}{\text{total no. of fissions caused by fission neutrons}}$

D. $\dfrac{\text{number of fissions caused by delayed neutrons}}{\text{number of fissions caused by prompt neutrons}}$

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B1050

Compared to the effective delayed neutron fraction (β_{eff}), the delayed neutron fraction (β)...

A. changes due to fuel depletion, whereas β_{eff} will remain constant over core life.

B. is based on a finite-sized reactor, whereas β_{eff} is based on an infinite-sized reactor.

C. describes the fraction of fission neutrons born delayed, whereas β_{eff} describes the fraction of fissions caused by delayed neutrons.

D. considers only the decay constant of the longest lived delayed neutron precursors, whereas β_{eff} considers the weighted average of all the decay constants.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B1172 (P2272)

A reactor is operating at 100% power at the end of core life. The greatest contribution to core heat production is being provided by the fission of...

A. U-235 and U-238.

B. U-238 and Pu-239.

C. U-235 and Pu-239.

D. U-238 and Pu-241.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B1251

The effective delayed neutron fraction (β_{eff}) takes into account two factors not considered in calculating the delayed neutron fraction (β). These factors consider that:

Delayed neutrons are ____________ likely to cause fast fission than prompt neutrons; delayed neutrons are ____________ likely to leak from the core than prompt neutrons.

A. less; more

B. less; less

C. more; more

D. more; less

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B1671 (P1672)

A refueling outage has just been completed in which one-third of the core was replaced with new fuel assemblies. A reactor startup has been performed to mark the beginning of the sixth fuel cycle and power is being increased to 100%.

Which one of the following pairs of reactor fuels will be providing the greatest contribution to core heat production when the reactor reaches 100% power?

A. U-238 and Pu-239

B. U-238 and Pu-241

C. U-235 and U-238

D. U-235 and Pu-239

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B2250 (P2249)

Which one of the following distributions of fission percentages in a reactor will result in the largest reactor core effective delayed neutron fraction?

	U-235	U-238	Pu-239
A.	90%	7%	3%
B.	80%	6%	14%
C.	70%	7%	23%
D.	60%	6%	34%

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B2349 (P2348)

Which one of the following fission percentage distributions occurring in a reactor will result in the smallest effective delayed neutron fraction?

	U-235	U-238	Pu-239
A.	90%	7%	3%
B.	80%	6%	14%
C.	70%	7%	23%
D.	60%	6%	34%

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B2469

A refueling outage has just been completed in which the entire core was offloaded and replaced with new fuel. A reactor startup has been performed to mark the beginning of the next fuel cycle and power is being increased to 100%.

Which one of the following pairs of reactor fuels will be providing the greatest contribution to core heat production when the reactor reaches 100% power?

A. U-235 and U-238

B. U-238 and Pu-239

C. U-235 and Pu-239

D. U-235 and Pu-241

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.04 [2.5/2.5]
QID: B2950 (P2948)

A typical BWR reactor plant is operating at equilibrium 50% power when a control rod is ejected from the core. Which one of the following combinations of fission percentages, by fuel, would result in the shortest reactor period? (Assume the reactivity worth of the ejected control rod is the same for each case.)

Percentage of Fissions by Fuel

	U-235	U-238	Pu-239
A.	90%	8%	2%
B.	80%	9%	11%
C.	70%	9%	21%
D.	60%	8%	32%

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.05 [3.7/3.7]
QID: B249

During a reactor startup, the intermediate range monitor readings go from 30% to 65% on the same range in 2 minutes with no operator action. Which one of the following is the average reactor period during the power increase?

A. 357 seconds

B. 173 seconds

C. 155 seconds

D. 120 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.05 [3.7/3.7]
QID: B851

If reactor power changes from 10^{-5}% to 10^{-6}% in 5 minutes, the average reactor period is:

A. negative 80 seconds.

B. positive 80 seconds.

C. negative 130 seconds.

D. positive 130 seconds.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.05 [3.7/3.7]
QID: B2751 (P2748)

A reactor is exactly critical at 10^{-8}% power during a reactor startup. β for this reactor is 0.0072. Which one of the following is the approximate amount of positive reactivity that must be added to the core by control rod withdrawal to initiate a reactor power increase toward the point of adding heat with a stable reactor period of 26 seconds?

A. 0.2% ΔK/K

B. 0.5% ΔK/K

C. 1.0% ΔK/K

D. 2.0% ΔK/K

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.05 [3.7/3.7]
QID: B3151 (P3148)

A reactor is being started for the first time following a refueling outage. Reactor Engineering has determined that during the upcoming fuel cycle $\overline{\beta}_{eff}$ will range from a maximum of 0.007 to a minimum of 0.005.

Once the reactor becomes critical, control rods are withdrawn to insert a net positive reactivity of 0.1% ΔK/K into the reactor core. Assuming no other reactivity additions, what will be the approximate stable reactor period for this reactor until the point of adding heat is reached?

A. 20 seconds

B. 40 seconds

C. 60 seconds

D. 80 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B250

Without delayed neutrons in the neutron cycle, when positive reactivity is added to a critical reactor, the reactor will...

A. experience a prompt jump in power level followed by a decrease to the initial power level.

B. experience a rapid but controllable power increase.

C. begin an uncontrollable rapid power increase.

D. not be able to attain criticality.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.6 [3.7/3.7]
QID: B451 (P47)

A small amount of reactivity is added to a critical reactor in the source/startup range. The amount added is less than the average effective delayed neutron fraction.

Which one of the following will have a significant effect on the magnitude of the stable reactor period achieved for this reactivity addition?

A. Moderator temperature coefficient

B. Fuel temperature coefficient

C. Prompt neutron lifetime

D. Average effective decay constant

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1250 (P1548)

Two reactors are identical in every way except that reactor A is at end of core life and reactor B is at the beginning of core life. Both reactors are critical at 10^{-5}% power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor ______ because it has a ___________ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1349 (P1248)

Two reactors are identical except that reactor A is at the end of core life and reactor B is at the beginning of core life. Both reactors are operating at 100% power when a reactor scram occurs at the same time on each reactor.

If the reactor systems for each reactor respond identically to the scram and no operator action is taken, reactor A will attain a negative ________ second stable period and reactor B will attain a negative ________second stable period. (Assume control rod worth equals -0.9700 $\Delta K/K$ and λ_{eff} equals 0.0124 $seconds^{-1}$ for both reactors.)

A. 80; 56

B. 80; 80

C. 56; 56

D. 56; 80

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1649 (P1649)

Two reactors are identical in every way except that reactor A is at the end of core life and reactor B is at the beginning of core life. Both reactors are operating at 100% power when a reactor scram occurs at the same time on each reactor.

If the reactor systems for each reactor respond identically to the scram and no operator action is taken, a power level of 10^{-5}% will be reached first by reactor _____ because it has a ____________ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1751 (P1749)

Which one of the following is the reason that delayed neutrons are so effective at controlling the rate of reactor power changes?

A. Delayed neutrons make up a large fraction of the fission neutrons in the core compared to prompt neutrons.

B. Delayed neutrons have a long mean lifetime compared to prompt neutrons.

C. Delayed neutrons produce a large amount of fast fission compared to prompt neutrons.

D. Delayed neutrons are born with high kinetic energy compared to prompt neutrons.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B1950 (P48)

Over core life, plutonium isotopes are produced with delayed neutron fractions that are _______________ than uranium delayed neutron fractions, thereby causing reactor power transients to be _______________ near the end of core life.

A. larger; slower

B. larger; faster

C. smaller; slower

D. smaller; faster

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B2450 (P348)

Which one of the following statements describes the effect of changes in the delayed neutron fraction from beginning of core life (BOL) to end of core life (EOL)?

A. A given reactivity addition to a shutdown reactor at EOL yields a larger change in shutdown margin (SDM) than at BOL.

B. A given reactivity addition to a shutdown reactor at EOL yields a smaller change in SDM than at BOL.

C. A given reactivity addition to an operating reactor at EOL results in a longer reactor period than at BOL.

D. A given reactivity addition to an operating reactor at EOL results in a shorter reactor period than at BOL.

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B2651 (P1149)

Delayed neutrons are important for reactor control because...

A. they are produced with higher average kinetic energy than prompt neutrons.

B. they prevent the moderator temperature coefficient from becoming positive.

C. they are the largest fraction of the neutrons produced from fission.

D. they greatly extend the average lifetime of each neutron generation.

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B2850 (P2849)

Two reactors are identical in every way except that reactor A is at the beginning of core life and reactor B is at the end of core life. Both reactors are critical at 10^{-5}% power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor ______ because it has a ___________ delayed neutron fraction.

A. A; smaller

B. A; larger

C. B; smaller

D. B; larger

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3249 (P3248)

Two nuclear reactors are identical in every way except that reactor A is near the end of core life and reactor B is near the beginning of core life. Both reactors are operating at 100% power when a reactor scram occurs at the same time on each reactor. The reactor systems for each reactor respond identically to the scram and no operator action is taken.

Ten minutes after the scram, the higher fission rate will exist in reactor ______ because it has a ___________ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B251

As the core ages, the amount of positive reactivity required to make the reactor prompt critical will ______________ because the effective delayed neutron fraction ______________.

A. increase; decreases

B. decrease; increases

C. decrease; decreases

D. increase; increases

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B551

A reactor is operating at 50% power with the following conditions:

Power defect	= 0.03% $\Delta K/K$
Shutdown margin	= 0.05% $\Delta K/K$
Effective delayed neutron fraction	= 0.007
Effective prompt neutron fraction	= 0.993

How much positive reactivity must be added to take this reactor "prompt critical"?

A. 0.03% $\Delta K/K$

B. 0.05% $\Delta K/K$

C. 0.7% $\Delta K/K$

D. 0.993% $\Delta K/K$

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B664

A critical reactor will become prompt critical if the reactivity added is equal to the effective...

A. delayed neutron decay constant.

B. delayed neutron fraction.

C. prompt neutron decay constant.

D. prompt neutron fraction.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B950

A reactor is operating at 75% power with the following conditions:

Total control rod worth	= -0.0753 ΔK/K
Shutdown margin	= 0.0042 ΔK/K
Effective delayed neutron fraction	= 0.0058
Effective prompt neutron fraction	= 0.9942

How much positive reactivity must be added to make the reactor "prompt critical"?

A. 0.0042 ΔK/K

B. 0.0058 ΔK/K

C. 0.0753 ΔK/K

D. 0.9942 ΔK/K

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B1150 (P1948)

Positive reactivity is continuously added to a critical reactor. Which one of the following values of core K_{eff} will first result in a prompt critical reactor?

A. 1.0001

B. 1.001

C. 1.01

D. 1.1

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B1850 (P1449)

A reactor is critical at 10^{-5}% power with a xenon-free core. The operator continuously withdraws control rods until a 60-second reactor period is reached and then stops control rod motion.

Upon stopping rod withdrawal, reactor period will immediately...

A. stabilize at 60 seconds until power reaches the point of adding heat (POAH).

B. lengthen and then stabilize at a value greater than 60 seconds until power reaches the POAH.

C. shorten and then slowly and continuously lengthen until power reaches the POAH.

D. lengthen and then slowly and continuously shorten until power reaches the POAH.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B2051

A reactor is exactly critical at the point of adding heat with a xenon-free core. Reactor vessel temperature is 175°F. The operator then inserts control rods until a negative 100 second period is attained and then stops control rod motion.

When rod motion is stopped, reactor period will immediately _________ until power approaches the equilibrium subcritical multiplication source range level and then approach ________.

A. stabilize at negative 100 seconds; infinity.

B. stabilize at negative 100 seconds; zero.

C. lengthen and then stabilize; infinity.

D. lengthen and then stabilize; zero.

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B2550 (P2549)

A reactor was stable at 80% power when the reactor operator withdrew a control rod continuously for 2 seconds. Which one of the following affects the amount of "prompt jump" increase in reactor power for the control rod withdrawal?

A. The duration of control rod withdrawal

B. The differential control rod worth

C. The total control rod worth

D. The magnitude of the fuel temperature coefficient

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B2951 (P2949)

A reactor is operating at 75% power with the following conditions:

Power defect	= -0.0185 $\Delta K/K$
Shutdown margin	= 0.0227 $\Delta K/K$
Effective delayed neutron fraction	= 0.0061
Effective prompt neutron fraction	= 0.9939

How much positive reactivity must be added to make the reactor "prompt critical"?

A. 0.0061 $\Delta K/K$

B. 0.0185 $\Delta K/K$

C. 0.0227 $\Delta K/K$

D. 0.9939 $\Delta K/K$

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B3250 (P3249)

Refer to the unlabeled reactor response curve shown below for a reactor that was initially stable in the source range. Both axes have linear scales. A small amount of positive reactivity was added at time = 0 sec.

The response curve shows ___________ versus time for a reactor that was initially _________.

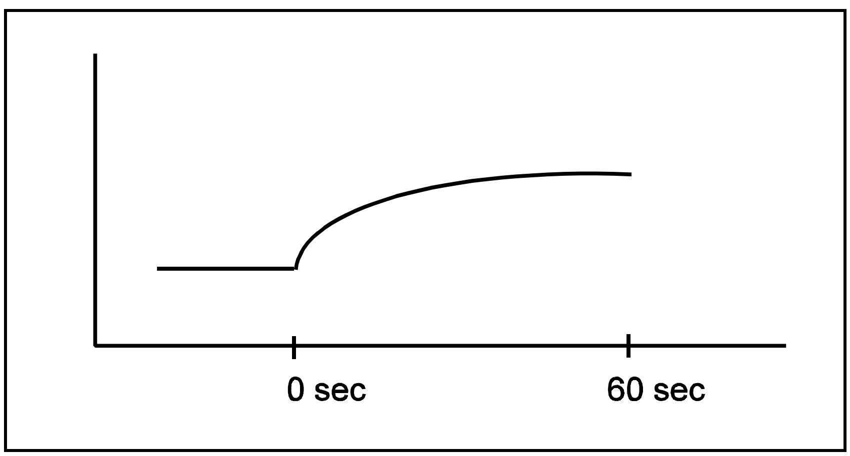
A. reactor period; subcritical

B. reactor period; critical

C. reactor fission rate; subcritical

D. reactor fission rate; critical

ANSWER: C.



TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B3351 (P549)

Which one of the following describes a condition in which a reactor is prompt critical?

A. A very long reactor period makes reactor control very sluggish and unresponsive.

B. The fission process is occurring so rapidly that the delayed neutron fraction approaches zero.

C. Any increase in reactor power requires a reactivity addition equal to the fraction of prompt neutrons in the core.

D. The net positive reactivity in the core is greater than or equal to the magnitude of the average effective delayed neutron fraction.

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B3450 (P3449)

Two reactors are exactly critical low in the intermediate range (well below the point of adding heat). The reactors are identical except that reactor A is near the beginning of core life (BOL) and reactor B is near the end of core life (EOL). Assume that a step addition of positive reactivity (0.001 $\Delta K/K$) is added to each reactor. Select the combination below that completes the following statement.

The size of the prompt jump in core power observed for reactor B (EOL) will be ___________ than reactor A (BOL); and the stable reactor period observed for reactor B (EOL) will be ___________ than reactor A (BOL).

A. smaller; longer

B. smaller; shorter

C. larger; longer

D. larger; shorter

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.07 (3.3/3.3)
QID: B3651 (P3649)

Refer to the unlabeled reactor response curve shown below for a reactor that was initially subcritical in the source range. A small amount of positive reactivity was added at time = 0 sec.

The response curve shows ____________ versus time for a reactor that is currently (at time = 60 sec) __________.

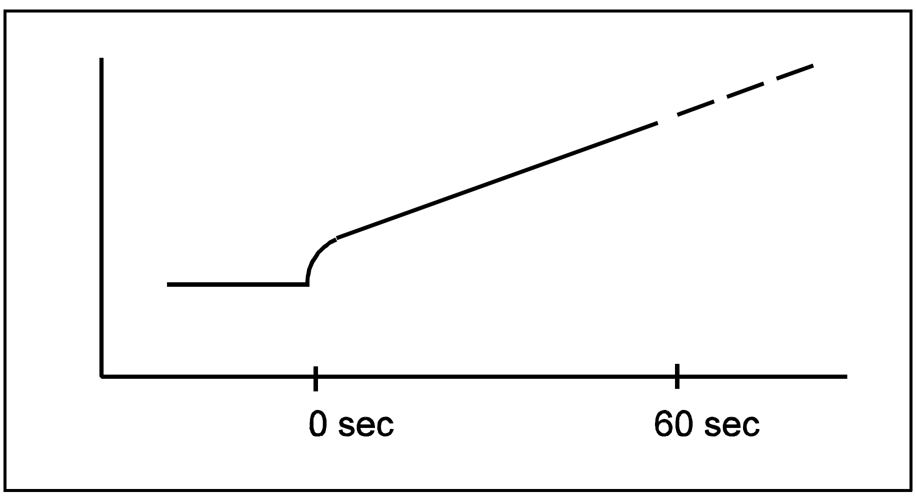
A. reactor period; exactly critical

B. reactor period; supercritical

C. reactor fission rate; exactly critical

D. reactor fission rate; supercritical

ANSWER: D.



TOPIC: 292003
KNOWLEDGE: K1.07 [3.3/3.3]
QID: B3750 (P3749)

A reactor is operating at equilibrium 75% power with the following conditions:

Total power defect	= -0.0176 $\Delta K/K$
Shutdown margin	= 0.0234 $\Delta K/K$
Effective delayed neutron fraction	= 0.0067
Effective prompt neutron fraction	= 0.9933

How much positive reactivity must be added to make the reactor "prompt critical"?

A. 0.0067 $\Delta K/K$

B. 0.0176 $\Delta K/K$

C. 0.0234 $\Delta K/K$

D. 0.9933 $\Delta K/K$

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B49

After initial criticality, the reactor period is stabilized. The source range channels are repositioned so that the count rate is 100 cps. Sufficient positive reactivity is added to establish a 120-second period. How much time will it take for the count rate to increase to 10,000 cps with no additional operator action?

A. 1.2 minutes

B. 4 minutes

C. 9.21 minutes

D. 15.82 minutes

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B127

A reactor is operating at a power level of 120 watts. A control rod is inserted, which results in a stable negative 80-second period. Which one of the following is closest to the reactor power level 2 minutes after rod insertion? (Assume the period stabilized immediately after rod insertion.)

A. 27 watts

B. 32 watts

C. 49 watts

D. 54 watts

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
K1.05 [3.7/3.7]
QID: B1651 (P2648)

During a reactor startup, the intermediate range monitor readings increase from 30% to 50% on the same range in 2 minutes with no operator action. Which one of the following is the average reactor period during the power increase?

A. 357 seconds

B. 235 seconds

C. 155 seconds

D. 61 seconds

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.05 [3.7/3.7]
K1.06 [3.7/3.7]
QID: B3551 (P3548)

Reactors A and B are identical except that the reactor cores are at different times in core life. The reactor A effective delayed neutron fraction is 0.007, and the reactor B effective delayed neutron fraction is 0.005. Both reactors are currently subcritical and stable with neutron flux level in the source range.

Given:

Reactor A $K_{eff} = 0.999$
Reactor B $K_{eff} = 0.998$

If positive 0.003 $\Delta K/K$ is suddenly added to each reactor, how will the resulting stable periods compare? (Consider only the reactor response while power is below the point of adding heat.)

A. Reactor A stable period will be shorter because it will have the higher positive reactivity in the core.

B. Reactor B stable period will be shorter because it has the smaller effective delayed neutron fraction.

C. Reactors A and B will have the same stable period because both reactors will remain subcritical.

D. Reactors A and B will have the same stable period because both reactors received the same amount of positive reactivity.

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3650 (P3648)

Two reactors are identical in every way except that reactor A is at the beginning of core life and reactor B is near the end of core life. Both reactors are operating at 100% power when a reactor scram occurs at the same time on each reactor. The reactor systems for each reactor respond identically to the scram and no operator action is taken.

Ten minutes after the scram, the higher shutdown fission rate will exist in reactor ______ because it has a ___________ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3749 (P3748)

A step positive reactivity addition of 0.001 ΔK/K is made to a reactor with a stable neutron population and an initial core K_{eff} of 0.99. Consider the following two cases:

Case 1: The reactor is near the beginning of core life.
Case 2: The reactor is near the end of core life.

Assume the initial core neutron population is the same for each case.

Which one of the following correctly compares the prompt jump in core neutron population and the final stable core neutron population for the two cases?

A. The prompt jump will be greater for case 1, but the final stable neutron population will be the same for both cases.

B. The prompt jump will be greater for case 2, but the final stable neutron population will be the same for both cases.

C. The prompt jump will be the same for both cases, but the final stable neutron population will be greater for case 1.

D. The prompt jump will be the same for both cases, but the final stable neutron population will be greater for case 2.

ANSWER: B.

TOPIC: 292003
KNOWLEDGE: K1.06 [3.7/3.7]
QID: B3851

A reactor is critical in the source range during the initial reactor startup immediately following a refueling outage. The core average delayed neutron fraction is 0.007. The operator adds positive reactivity to establish a stable positive 60-second reactor period.

If the reactor had been at the end of core life with a core average delayed neutron fraction of 0.005, what would be the approximate stable reactor period after the addition of the same amount of positive reactivity?

A. 28 seconds

B. 32 seconds

C. 36 seconds

D. 40 seconds

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B1252

During a continuous rod withdrawal accident, reactor power has increased from 387 MW to 553 MW in 10 seconds. What was the average reactor period for this power increase?

A. 3 seconds

B. 24 seconds

C. 28 seconds

D. 35 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B2351 (P2349)

During a reactor startup, the intermediate range monitor readings increase from 20% to 40% on the same range in 2 minutes with no operator action. Which one of the following is the average reactor period during the power increase?

A. 173 seconds

B. 235 seconds

C. 300 seconds

D. 399 seconds

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B3051 (P3050)

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power stable at the point of adding heat, a control rod malfunction causes an inadvertent rod withdrawal that results in adding 0.3 %ΔK/K reactivity.

Given:

All rod motion has been stopped.
No automatic system or operator actions occur to inhibit the power increase.
Power coefficient = -0.04 %ΔK/K / % power
Average effective delayed neutron fraction = 0.006

What is the approximate power level increase required to offset the reactivity added by the inadvertent rod withdrawal?

A. 3.0%

B. 5.0%

C. 6.7%

D. 7.5%

ANSWER: D.

TOPIC: 292003
KNOWLEDGE: K1.08 [2.7/2.8]
QID: B3451 (P3467)

A reactor core is exactly critical well below the point of adding heat during a plant startup. A small amount of positive reactivity is then added to the core, and a stable positive reactor period is established.

With the stable positive reactor period, the following is observed:

Time	Power Level
0 sec	3.16×10^{-7}%
90 sec	1.0×10^{-5}%

Which one of the following will be the reactor power at time = 120 seconds?

A. 3.16×10^{-5}%

B. 5.0×10^{-5}%

C. 6.32×10^{-5}%

D. 1.0×10^{-4}%

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B50

During a reactor startup, the reactor is critical at 3,000 counts per second (cps). A control rod is notched out, resulting in a doubling time of 85 seconds. How much time is required for the reactor to reach 888,000 cps?

A. 341 seconds

B. 483 seconds

C. 697 seconds

D. 965 seconds

ANSWER: C.

TOPIC: 292003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B352

Reactor power is increased from 50 kW to 370 kW in 2 minutes. Select the doubling time.

A. 42 seconds

B. 60 seconds

C. 86 seconds

D. 120 seconds

ANSWER: A.

TOPIC: 292003
KNOWLEDGE: K1.09 [2.5/2.6]
QID: B1451

During a startup, the reactor is critical at 3000 cps. A control rod is notched out, resulting in a doubling time of 115.2 seconds. Which one of the following is the approximate reactor period?

A. 56 seconds

B. 80 seconds

C. 126 seconds

D. 166 seconds

ANSWER: D.